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LUBRICATION OF AIRCRAFT ENGINES AT LOW TEMPERATURES

The characteristics of lubricants and lubrication systems, with particular reference to the extent to which they are influenced by change in temperature, are being studied by the automotive power plants section of the bureau under authorization from the Bureau of Aeronautics of the Navy Department. For this purpose an air-cooled radial engine has been mounted in one of the altitude chambers in which the necessary low temperatures can readily be obtained. The engine is provided with complete equipment for measuring oil flow under various conditions. Measurements with this engine are being paralleled by an experimental study of the pump and other elements of the lubrication system.

This work is of fundamental importance because at low temperatures the transfer of the oil from the supply tank to the pump and thence to the bearing surfaces is attended with a great deal of difficulty. Indeed, under these conditions oil may flow more slowly than the proverbial "cold molasses." Therefore, the dimensions of the pump and feed lines must be sufficient to insure adequate lubrication, and yet provision must be made to prevent overcooling when temperature conditions are such that the oil flows freely.

MEETING OF RADIO ADVISORY COMMITTEE OF BUREAU OF STANDARDS

The Bureau of Standards maintains contact with a great number of industries through advisory committees which assist and advise the bureau in formulating its program of work. Such a committee was recently formed representing the radio industry, with the following representatives:

Institute of Radio Engineers, L. A. Hazeltine.

American Institute of Electrical Engineers, Prof. A. E. Kennelly.

American Radio Relay League, Robert S. Kruse.

National Association of Broadcasters, G. Lewis.

American Telephone & Telegraph Co., O. B. Blackwell.

Radio Corporation of America, Dr. A. N. Goldsmith.

General Electric Co., E. M. Kinney.

Westinghouse Electric & Manufacturing Co., F. Conrad.

Associated Manufacturers of Electrical Supplies, radio apparatus section, R. H. Manson.

The committee held its first meeting at the bureau on March 9 and spent the day making a careful inspection of the radio laboratory and a study of the program of work in progress. The committee also met with the director and members of the bureau's staff concerned with radio work and made preliminary recommendations on the program. The work of the bureau's radio laboratory comprises projects under the following headings: Maintenance of standards, testing of instruments, research on standards and methods of measurement, general research for the improvement of radio, special radio work for Government departments, and certain nonresearch projects, such as reference and information service, the promotion and coordination of radio research in other institutions, and participation in the work of various radio and standardizing organizations.

NATIONAL ELECTRICAL SAFETY CODE

The third edition of the National Electrical Safety Code was completed in 1920 and issued in 1921. It is contem-

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plated that this code will be revised from time to time as experience with it may dictate and a fourth edition of the code has now been prepared, the revision having been made by two committees of national scope organized according to the procedure of the American Engineering Standards Committee. One of these committees dealt with line construction and operation and the other with indoor installations.

In addition to publishing the code as a whole in its revised form, the bureau will issue the several parts also as separate publications. The committee dealing with indoor work was the first to complete its labors, and part 1 of the fourth edition of the code has now been issued as Handbook No. 6 of the Bureau of Standards, entitled "Safety Rules for the Installation and Maintenance of Electrical Supply Stations." Copies can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents each.

Part 3 of the code containing safety rules for the installation and maintenance of electric utilization equipment is now in press and will soon be issued as Handbook No. 7.

IDENTIFICATION MARKS ON PIPING IN MANUFACTURING PLANTS, POWER STATIONS, ETC.

On March 31 the chief of the bureau's section of safety engineering attended a conference in New York City dealing with a proposed scheme for identifying the contents of piping systems used in manufacturing plants, power stations, oil refineries, and similar situations where there is sufficient piping involved to render identification necessary.

A committee of national scope on which various Government departments are represented was organized some time ago to deal with this subject under the procedure of the American Engineering Standards Committee. This committee favors the use of stenciled words rather than colors for the detailed identification of the contents of the pipes, but has drawn up a general classification of substances and proposes to indicate the class of material contained in any pipe by the use of a color. Five such classes have been recognized.

Objections to the scheme have been made by representatives of power stations, by architects and others, and these were considered at the meeting on March 31.

It was brought out at this meeting that it is not the committee's intention to recommend that the entire length of any run of pipe should be painted with the appropriate color, but that a band of color at points where identification is desired will be sufficient. Where complete identification by color marking is desired, a combination of bands of different colors may be used, as is now done by the Navy Department, and only one of these colors need be significant of the group to which the material in the pipe belongs. With these points clearly understood it is thought that the proposed system may prove generally acceptable.

Because of the large number of materials which must be handled in many manufacturing plants, especially those connected with chemical processes, it has not been considered possible to draw up a complete system of identification which would depend upon color alone.

PREVENTION OF MOLDS AND BACTERIA IN ELECTROTYPING SOLUTIONS

During his inspection of electrotyping plants J. H. Winkler, the research associate of the American Electrotypers Association stationed at the bureau, observed two interesting cases of excessive growth of molds and bacteria in nickel electrotyping solutions at two local plants. As these formations were causing a great deal of trouble and as the cases appeared to be unique, the advice of the Bureau of Chemistry was obtained on the best method of getting rid of the difficulty. Confirmatory experiments are being conducted in the laboratory, and in the meantime one of the plants has added thymol to the solutions. Thus far this has proved satisfactory.

NEW SERIES OF RUBBER INVESTIGATIONS

A new series of investigations has been started in the rubber section of the bureau. In these investigations possible ways of supplementing the natural supply of rubber will be studied. The work will

include such problems as the improvement of the quality of reclaimed rubber, the possibilities of synthetic rubber or rubber like substances, etc. For the present it is proposed to investigate the value of water dispersions as a means of improving the quality of reclaimed rubbers or other rubberlike materials.

SPECIFICATIONS FOR STITCHES, SEAMS, AND STITCHING

The specifications for Stitches, Seams, and Stitching recently promulgated by the Federal Specifications Board (F. S. B. No. 384) and published by the bureau as Circular No. 283, give an intelligent analysis of seams and stitching used in the fabrication of garments and sewed articles. Although primarily for use in connection with articles employed by the various Government departments, these specifications will probably be used to a great extent in the sewing industry.

The stitches are divided into six classes with several subdivisions of each class. All of the common types of seams are included and many of the stitching types, especially the nondecorative types. All of the stitches, seams, and stitching are not only defined but illustrated.

Circular No. 283 may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 20 cents.

FASTNESS OF DYE ON TENT DUCK

The bureau has been cooperating with one of the Government departments in the development of a fabric which would meet the requirements of the Marine Corps for tent duck which could be produced in a cotton mill belonging to the department. Especial attention was paid to the ability of the dye to withstand exposure to light and washing without fading. These features were especially stressed by the Marine Corps, and it was found that the fabrics submitted satisfactorily withstood the tests.

The dye fastness was of especial interest in view of the controversy which was aroused in the textile industry when a Government contract was placed two years ago with a foreign concern, stating that they were unable to obtain satisfactory materials in the United States. The bureau understands that this condition has since been changed, and the department in question is planning to equip this cotton mill to handle the Marine Corps contracts on the basis of these experiments.

ACID IN LEATHER

In connection with an investigation relative to the determination of harmful acidity in leather, a sample of light leather used for the bellows in photo-engraving cameras was examined for acid content as an explanation of its complete failure after a few years' use. The leather had the characteristic "red decay" appearance, and when examined by the usual method was found to contain 2 per cent sulphuric acid. New leather of the same kind also showed the same amount of acid and gave a test for pyrogallol tannins, indicating at least a partial sumac tannage. The presence of this amount of acid, both in the new and used leathers, appears satisfactorily to account for the deterioration, even though some accelerating influences may have been present under the conditions of use. The complexity of the combinations in leather make it difficult to establish analytically the source of this acid, but possibilities lay in the use of other materials in conjunction with the sumac for tanning and in the dye used for coloring.

The hydrogen-ion concentration of a solution of the new leather was 2.83, and the titratable acidity indicated the presence of about 0.6 per cent of free or easily hydrolized acid. Whereas this amount is not abnormal for some classes of leather, it does appear from the Ph value that the acid present was active. The important thing to record in this connection is that this unsatisfactory leather had a Ph value below 3, which is the minimum proposed by some experimenters as the criterion of the suitability of leather as influenced by the acid content.

CONDITIONING AND TESTING CABINET FOR PAPER

Paper, being hygroscopic, is considerably affected by the change in moisture content resulting from exposure to atmospheres of different relative humidities. This effect manifests itself in the physical properties of the paper. Hence,

in testing paper for strength and other physical properties it has become generally recognized that such tests must be carried out under fixed conditions of relative humidity. The most desirable procedure is the maintaining of a testing room at constant relative humidity at a definite temperature. This requires elaborate and expensive apparatus—a good automatic-control system costing several thousand dollars. Although such equipment, capable of automatically controlling the atmosphere in a room large enough to accommodate all testing equipment and the necessary operators, is highly desirable, most paper mills are without any control for humidity in testing owing to the excessive expense of the elaborate equipment. Hence, an attempt has been made at the bureau to meet this condition with a small, relatively inexpensive, testing unit having humidity control. Thus far the development of the apparatus has been confined to its application to the folding test, since this test is most affected by differences in humidity.

A cabinet has been designed in which the atmosphere is kept at a constant relative humidity by means of the well-known method of exposing the air to a sulphuric acid solution of definite concentration. The specific gravity of a sulphuric acid solution is a sufficient index of its relative vapor pressure. By passing air through a sulphuric acid solution of definite concentration or specific gravity in a manner which will thoroughly expose the air to the acid solution, the air assumes a relative vapor pressure in equilibrium with that of the acid. In the present case the air is bubbled through large bottles of acid solution through specially designed bubblers by means of an air blower which delivers about 1 cubic foot of air per minute. The whole circulatory air system forms a closed system, the same air being continuously recirculated so that once the relative humidity is established it is changed only by the moisture taken from or given to samples of paper to be tested. In order that the introduction of samples into the testing cabinet shall not upset the constant relative humidity surrounding the testing instrument an auxiliary conditioning chamber is provided in the outgoing air line. Samples to be tested are placed in this auxiliary conditioning chamber for a sufficient period to bring them to equilibrium with the conditioned air before they are brought into the testing cabinet proper for the folding test. The folding tester is inclosed in the air-tight cabinet and is operated by a motor situated on the outside of the cabinet, the connection being made by means of a shaft passing through a bearing in the wall of the cabinet. In order to carry out the folding test without opening the cabinet to the outside air, flexible sleeves are provided which terminate in rubber gloves. By this means all necessary operations of inserting the test strip, adjusting the tension, starting and stopping the tester, etc., are effected almost as easily as if one were inside the cabinet.

A progress report of this work was given by F. T. Carson before the February, 1926, meeting of the Technical Association of the Pulp and Paper Industry. This was published in the following journals: Paper Trade Journal, February 25, 1926; Paper Mill and Wood Pulp News, March 13, 1926.

OBSERVATIONS ON PHOSPHORUS IN WROUGHT IRON MADE BY DIFFERENT PUDDLING PROCESSES

Wrought iron has been an important structural material for many centuries. Even to-day, in spite of the keen competition with steel, there are many purposes for which it is preferred to steel by engineers. The dearth of reliable published information on the properties of wrought iron from the viewpoint of modern metallurgy is surprising. An investigation recently completed by the bureau had for its purpose the study of the effect of phosphorus, one of the ever-present impurities in wrought iron, upon the properties of the finished iron as made by different puddling processes. Recently mechanical puddling processes have been advocated and used to a considerable extent in the manufacture of wrought iron to replace the time-honored hand-puddling method, on account of the high labor costs the use of the latter necessarily entails. Very little has been published on the properties of the wrought iron made by these newer processes.

Phosphorus in wrought iron is usually regarded with some concern, since it embrittles the iron; that is, makes it "cold short." The phosphorus is contained in both the iron matrix and the slag threads to which the wrought iron owes its characteristic "fiber." Only the phosphorus in the iron matrix, however, affects the properties of the metal. Mechanical puddling appears to be more effective in reducing the phosphorus content to a lower figure than is hand puddling. Experiments were carried out on wrought iron made by each of the two methods on a "split" heat of pig iron, the two parts of the heat being refined by the two processes, hand and mechanical puddling, respectively. For certain purposes, such as drill pipe for which a "stiff" material is needed, a certain percentage of phosphorus in the iron is desirable. The amount in such a case is usually considerably higher than that in good quality bar iron for which the total phosphorus ought not to exceed very much 0.15 per cent.

The investigation was not extensive enough to warrant any sweeping conclusion concerning all the merits of wrought iron made by the two processes. However, nothing was noted which would show that wrought iron made by hand puddling can not be equaled by mechanical puddling if properly carried out.

PRECISE METHOD FOR MEASURING THERMAL DILATION OF GLAZED WARE

The bureau has recently perfected an optical method for measuring with extreme accuracy the thermal expansion of the glazes used in the ceramic industry. An accurate knowledge of this property will aid in reducing the losses from cracking of the glaze.

Glazed ware, which consists of a body of clay (terra cotta, porcelain, or white ware) covered with a thin vitreous layer of a material of differing composition, is used extensively in the building trades as well as for dishes, sanitary ware, and objects of art. The large percentage of failure of this sort of ware due to cracking of the glaze is a serious defect and one responsible for enormous losses to the ceramic industry as well as to builders and other users. That the ceramic industry is alive to this condition is evidenced by the fact that manufacturers' associations are spending large sums each year on research work in hopes of correcting it.

Since a glaze is by its nature brittle and is only one or two hundredths of an inch thick, the only logical way to prevent its rupture is to reduce the stresses below its yield point. The stresses introduced into the ware by a differing rate of contraction between body and glaze during the last cooling in the furnace are enough to rupture the glaze at once or to reduce its resistance to subsequent stresses. Since the thermal expansions of both glazes and bodies can be changed by the addition of other constituents, it would seem to be a simple matter to match the two materials, provided their physical properties were known. The trouble has been that the methods of obtaining the thermal expansivities of the glazes have been so far in error as to mislead rather than help in a solution of the difficulty. The bureau has developed a method for measuring this property of a glaze as it exists under the conditions of manufacture, which agrees in all observed cases with the actual condition of the glaze. Measurements on samples produced according to the old method gave diametrically opposite and misleading indications. The method developed by the bureau if used in conjunction with proper factory control should assist the manufacturer to eliminate this cause of failure.

A NEW TYPE PORCELAIN PROTECTION TUBE

The choice of a proper protection tube for a thermocouple is nearly as important as the selection of the material for the couple. One of the most important properties of such a tube is low porosity to gases, since furnace gases usually attack the couple.[1] There are three general methods of attaining this low porosity: (*a*) By burning a refractory tube to a very high temperature (3,000° F.); (*b*) by adding a flux (such as feldspar) to a refractory body causing it to vitrify at a considerably lower temperature (2,550° to 2,700° F.); and (*c*) by coating a refractory body, which is not burned

[1] B. S. Tech. Paper No. 170, p. 89.

at a temperature sufficiently high to vitrify it, with an impervious glaze.

The first method is expensive and not generally practicable, and the second results in tubes which are apt to deform at operating temperatures. The third method produces tubes of satisfactory quality, is comparatively convenient, and has been adapted by this bureau to the production (by the "one-fire" method) of tubes for use in the ceramic laboratory. However, the "freezing" of the glaze to the wall of the furnace, or the ware with which it comes in contact, is a constant source of annoyance and loss of tubes by breakage. This is particularly true of laboratory work, the nature of which does not permit usually of permanent installations of tubes.

The bureau has overcome this difficulty by the production of a "double tube" which is highly refractory, satisfactorily rigid at operating temperatures, and which is rendered impervious to gases by a coating of glaze between the double wall of the tube. The tube is formed by casting first a thin tube of the body composition, followed immediately by a cast (or coating) of the glaze, and then a third coating using the body composition to form the inner wall of the tube. When dry, this double-wall tube can be removed from the mold and burned in the usual manner.

PAPER ON ANNEALING OF GLASS

The reduction of strain in glass or the annealing of glass, is a very important operation in its manufacture, because if not properly annealed glass is very liable to break either spontaneously or when subjected to the temperature changes incident to ordinary use, such as in washing or sterilizing.

Strain is a result of the rapid reduction of the temperature of the glass when it is molded and too rapid cooling after molding. In order to remove strain, the glass should be held at some temperature in the annealing range long enough to permit the stresses to disappear and then cooled so slowly that they do not develop again.

The annealing range varies with the composition of the glass; thus the annealing range for one soda-lime glass is between 480° and 530° C. and for another, between 560° and 620° C.; for a lead glass it may be between 440° and 500° C. For any given glass the annealing range is indicated by changes in its expansion or heat absorption as the temperature is increased. The safe cooling rate is governed by the thickness of the glass and it increases as the temperature decreases. Glass 1 cm. thick can be cooled at about 100° C. per hour (initial rate), the cooling rate for glass 2 cm. thick is 25° C. per hour, and for glass 5 cm. thick it becomes 4° C. per hour.

The degree of annealing or the amount of strain is generally determined by examining the glass in a beam of polarized light; no definite statement can be made regarding permissable amounts of strain, as it varies for different kinds of ware.

A paper on the annealing of glass has recently been prepared for publication in the Journal of the American Ceramic Society. This paper is nontechnical in its nature and was prepared especially for those who do not have the time nor facilities for reading some of the more elaborate papers on this subject. A few curves are given to illustrate the location of the annealing range by means of thermal expansion or heat absorption measurements, and a complete description of the construction of one type of apparatus for determining strain in glass is included

EFFECT ON MARBLE OF SOLUBLE SALTS IN CLEANING MATERIALS

It has long been recognized that solutions of various salts when allowed to penetrate the pores of stone, brick, or similar materials are apt to cause trouble because of recrystallization and internal pressure thus developed. The most common example of this is when the soluble matter is leached out of masonry walls forming an efflorescence on the surface and usually a considerable amount of decay due to some of the salts crystallizing within the pores near the surface.

The possibility of a similar action, due to sodium carbonate or tri-sodium phosphate in cleaning materials when interior

marblework is scrubbed with such preparations, has recently been under consideration. Occasionally a costly marble installation which is frequently cleaned has been found to show signs of decay in such a way as to indicate that the trouble has been caused by penetration of salts. Practically all of the trade cleaning preparations used for this purpose contain one of the above-mentioned salts.

The bureau is cooperating with the National Association of Marble Dealers in a study of this question, and the results to date indicate that such action does take place under ordinary cleaning conditions. The method of studying this problem consists mainly of a long period scrubbing test in which numerous marble slabs are submitted to 120 scrubbings with the cleaning preparation under consideration. Between successive scrubbings the marble specimens are allowed to dry in order to induce crystallization of any salt which may have penetrated during the scrubbing. After the scrubbing with a certain cleaning preparation has been completed the marble slabs are tested transversely for flexural strength, elasticity, and yield point. These properties are then compared with the same determinations made on slabs of the marble in the original condition; that is, without scrubbing.

One test with a tri-sodium phosphate composition has indicated a loss of strength of 10 per cent, a lowering of the elastic modulus of 4 per cent, and a reduction of the yield point of 14 per cent. Since each scrubbing is somewhat more prolonged in the test than is usually the case in actual scrubbing it is hardly fair to infer that this action takes place at the same rate under service conditions; however, it is believed that marblework which is cleaned each day would be affected to the same extent in one year, and that signs of decay would be observed in 10 or 20 years.

The research work has been limited to determining the effect of such action on marble. However, the same action evidently takes place on other floor and wall materials, such as concrete, terrazzo, slate, etc., and therefore the experiments are of general interest. Because of the low absorption of marble it seems likely that it would probably be less affected in this way than many of the other materials.

An article which discusses in some detail the results of work along this line will be published in an early issue of the journal Through the Ages, published by the Thomsen-Ellis Co., Baltimore, Md.

MEETING OF THE GYPSUM COMMITTEE OF THE AMERICAN SOCIETY FOR TESTING MATERIALS

On March 12 and 13 the regular annual spring meeting of Committee C–11 on Gypsum of the American Society for Testing Materials was held at the bureau. Representatives of both producers and nonproducers were present. A number of interesting reports relative to different phases of work on gypsum were presented which included the following:

"Errors in the analysis of gypsum and gypsum products," by H. F. Gardner, chemist, Beaver Products Co.

"Comparative results of the compressive strength of poured-in-place gypsum construction upon various shapes and sizes of specimens," by H. E. Brookby, United States Gypsum Co., and H. E. Marks, the H. E. Marks Corporation.

"A new method for measuring the consistency of gypsum mixes," by H. E. Brookby, United States Gypsum Co.

"The elasticity of gypsum mixes," by L. E. Smith, Bureau of Standards.

"The effect of admixtures to gypsum," J. P. C. Peter, research associate, The Gypsum Industries, Bureau of Standards.

"The measurement of plasticity of gypsum-sand mixes," by J. P. C. Peter, research associate, The Gypsum Industries, Bureau of Standards.

After the meeting a trip was made through the laboratories of the bureau in which work on gypsum is being conducted. This included a visit to the sound chamber where the acoustical properties of gypsum products are being determined, to the panel furnace where gypsum products are being measured for their fire-resistive properties, and the gypsum section where general studies are being made upon gypsum and gypsum products.

MARCH, 1926, PUBLICATIONS

Additions to "Supplementary List of Publications of the Bureau of Standards" (Beginning July 1, 1925)

Scientific Papers

S516. A shielded resistor for voltage transformer testing. Francis B. Silsbee. Price, 15 cents.

S519. The preparation of levulose. Richard F. Jackson, Clara Gillis Silsbee, and Max J. Proffitt. Price, 10 cents.

Technologic Papers

T303. Causes of some accidents from gas appliances. I. Vernon Brumbaugh. Price, 30 cents.

T304. A method for testing gas appliances to determine their safety from producing carbon monoxide. E. R. Weaver, J. H. Eiseman, and G. B. Shawn. Price, 10 cents.

T306. A photometric method for measuring the hiding power of paints. H. D. Bruce. Price, 10 cents.

T307. Durability of cement drain tile and concrete in alkali soils: Fourth progress report (1923). G. M. Williams and Irving Furlong. Price, 20 cents.

T308. Cement-lime mortars. H. V. Johnson. Price, 15 cents.

T309. Behavior of synthetic tanning materials toward hide substance. Edward Wolesensky. Price, 5 cents.

Circulars

C279. Relations between the temperatures, pressures, and densities of gases. Price, 25 cents.

C281. The technology of the manufacture of gypsum products. Price, 30 cents.

C295. Temperature corrections to readings of Baumé hydrometers, Bureau of Standards Baumé scale for sugar solutions (standard at 20° C.). Price, 5 cents.

C300. Architectural acoustics. Price, 5 cents.

United States Government Master Specifications for—

C301. Ink, drawing, colored waterproof. Price, 5 cents.

C302. Shellac, flake orange. Price, 5 cents.

C303. Varnish, shellac. Price, 5 cents.

Simplified Practice Recommendations, Elimination of Waste

R16. Lumber (first revision). Price, 15 cents.

R38. Sand-lime brick. Price, 5 cents.

R42. Paper grocers' bags. Price, 5 cents.

R44. Box board thicknesses. Price, 5 cents.

Outside Publications

Home service for the radio set. M. S. Strock; Stevenson's Bulletin of Radio Broadcasting Stations, March 26, 1926, p. 3; New York Herald-Tribune, February 21, 1926, p. 9; Radio Age, March, 1926.

The work of the Bureau of Standards on rubber. C. E. Waters; Journal of Chemical Education, Vol. 3, No. 3, p. 291; March, 1926.

Determination of O_2 and H_2 by vacuum fusion. L. Jordan and J. R. Eckman; Industrial and Engineering Chemistry, Vol. 18, p. 279, March, 1926.

Effect of manganese, silicon, and phosphorus on the Pearlite interval. B. Kjerrman; Journal, American Society for Steel Treating, Vol. 9, p. 430, March, 1926.

Progress report on investigation of sagger clays. R. A. Heindl; Journal American Ceramic Society, Vol. 9, No. 3, p. 131, March, 1926.

Cleaning materials for marble. D. W. Kessler; Through the Ages, Vol. 3, No. 11, p. 3, March, 1926.

The Nation's fire losses and its causes. S. H. Ingberg; Safety Engineering, Vol. 51, No. 3, p. 135, March, 1926.

Arc spectrum regularities for ruthenium. W. F. Meggers and O. Laporte; Journal of the Washington Academy of Sciences; Vol. 16, No. 6, p. 143, March 19, 1926.

Aircraft Instruments. H. N. Eaton. K. H. Beij, W. G. Brombacher, W. W. Frymoyer, H. B. Henrickson, C. L. Seward, D. H. Strother; published by Ronald Press, New York City, March, 1926.

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